4 Drainage Construction Standards

4.1 General

A. On-site retainage of stormwater and implementation of other stormwater management measures to control the rate, volume and characteristics of stormwater discharged to the Town's storm drainage systems shall be required whenever feasible, with exceptions to be approved by the Town. Storm drains, culverts, catch basins, manholes, retention/detention structures, water quality structures, permeable surfaces, and related best management practices (BMPs), shall be installed where necessary to provide adequate treatment and onsite infiltration or offsite disposal of surface water from all streets and adjacent land as shown on the proposed plans that require approval by the Town prior to construction. Structural BMPs shall follow design practices outlined in Volume 2 of the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards: "Structural BMP Specifications for the Massachusetts Stormwater Handbook".

B. All projects that are reviewed for approval must meet the requirements set forth in the Stormwater Management Standards promulgated by the DEP under the Clean Water Act, M.G.L.c. 21, §§ 26-53 and its accompanying regulations 314 CMR 9.0 *Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters within the Commonwealth*; and 310 CMR 10.0 *Wetlands Protection Act Regulations*. Projects include all commercial and industrial construction or renovation; and all subdivisions as defined under the *Rules and Regulations Governing Subdivision of Land in the Town of Framingham*.

C. All proposals shall include plans that show the size and location of existing storm drainage facilities which the proposed system will tie into. Plans shall provide designs and calculations using a recognized engineering formula showing that the no additional runoff will be introduced into the drainage system as well as calculations and designs showing how the drainage system will meet the DEP Stormwater Management Standards. The plans shall include details and descriptions of erosion control and stormwater management during construction.

D. Driveways and other entrances to the street shall be constructed to prevent roadway drainage from entering the private property.

E. This manual contains standards for some common Best Management Practices (BMPs), which can also be found in the DEP's *Massachusetts Stormwater Handbook*. The inclusion of these standards is not meant to be an exhaustive listing of approved BMPs. The *Massachusetts Stormwater Handbook* shall be considered as a guide for other BMPs.

4.2 Private Connections to Town Drainage System

A. It is the responsibility of the property owner to manage and contain all stormwater drainage and groundwater on their property. Cellar floors and basement floors should be a minimum of 1 foot above the seasonal high ground water table to minimize the need for sump pumps. This is in accordance with the Town's Rules and Regulations Governing Subdivision of Land, Section VII I (21) but is also a useful benchmark for all construction in the Town.

B. Private drains, including building storm drains for new or existing buildings, groundwater sump drains, cellar drains, and drains from irrigation systems, shall generally not be connected directly to the Town's drainage system. Connections made after February 15, 2009 without Town approval shall be considered as illicit connections and shall be removed by the property owner or the DPW. Please see separate regulations regarding private drainage connections to the Town's drainage system.

4.3 Materials

A. The Materials section summarizes the Town's standardized components to be used. All materials shall conform to the latest version of the MassDOT Standard Specifications, as amended, and policies and technical guidance in DEP's Stormwater Management Standards and the Massachusetts Stormwater Handbook.

4.3.1 Bedding Material

A. Pipe, manholes, catch basins, and leaching basins shall be laid in any of the following materials, as specified hereafter or as approved by the inspector.

- Pea stone (3/8 inch in size)
- Angular crushed stone or rock, dense or open graded with little or no fines (¼ inch to 1 ½ inches in size).
- AASHTO classifications A1 and A3: Clean, coarse grained materials, such as gravel, coarse sands and gravel/sand mixtures (1 ½ inches maximum in size).
- AASHTO classifications A-2-4 and A-2-5: Coarse grained materials with fines including silty or clayey gravels or sands. Gravel or sand must comprise more than 50 percent of Class III materials (1 ½ inches maximum size).
- Approved material shall be sifted to remove rocks larger than 3 inches.

B. Backfill material placed above the bedding material and below the roadway foundation shall conform to 6.2.1. Roadway foundation and surface restoration shall conform to Section 5, Roadway Construction Standards, and Section 6, Existing Road Openings, as applicable.

4.3.2 Pipe

Polyvinyl chloride (PVC) pipe shall not be used in drainage systems within the Town right-of-way or other roadways.

4.3.2.1 High Density Polyethylene (HDPE) Pipe

A. The pipe shall conform to MassDOT Section M5.03.10. Pipe shall be smooth interior wall and corrugated exterior wall, and be water-tight. Pipe shall be minimum 12-inch diameter. Ends shall be bell-and-spigot unless approved by the DPW for the specific application. Pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252 and M294. Pipe shall support an HS-20 live load with a maximum deflection of 5% of the minimum pipe diameter. Pipe and fittings shall be made from virgin polyethylene compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. Nominal sizes of 12- to 60-inch shall be either AASHTO Type 'S' or Type 'D.'

4.3.2.2 Polypropylene (PP) Pipe

A. Pipe shall have a stiffness of 46 psi when tested in accordance with ASTM D2412. Pipe with 12" up to 30" ID shall have smooth interior wall and corrugated exterior wall, and be water-tight. Pipe from 30" to 60" ID shall have smooth interior wall and exterior wall with annular inner corrugations, and be water-tight to meet ASTM D3212. Pipe shall be minimum 12-inch diameter. Ends shall be bell-and-spigot unless approved by the DPW for the specific application. Pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252 and M294. Pipe shall support an HS-20 live load with a maximum deflection of 5% of the minimum pipe diameter. Pipe and fittings shall be made from virgin polypropylene

compounds which conform to the applicable current edition of the AASHTO Material Specifications as defined and described in ASTM D4101. Nominal sizes of 12- to 60-inch shall be either AASHTO Type 'S' or Type 'D.'

4.3.2.3 Reinforced Concrete Pipe (RCP)

A. Pipe and flared ends shall conform to the AASHTO M170 for Standard Strength Reinforced Concrete Culvert Pipe for class III Pipe, Wall B. or ASTM C76 for Reinforced Concrete Culvert and Storm Drain Pipe. All pipe 24 inches in diameter or smaller shall be of the bell and spigot type. Pipes larger than 24 inches in diameter shall be tongue and groove or bell and spigot. A preformed flexible plastic sealing compound of Butyl Mastic Rope Sealer " 1" size, "EZ Stick" as manufactured by Concrete Products supply or an approved equal shall be used for sealing water-tight joints.

4.3.2.4 Pipe Ends

A. The DPW prefers headwalls to pipe ends for most drainage conditions. Designs for pipe ends shall be submitted for approval by the DPW.

B. Flared end HDPE sections shall conform to MassDOT Section M5.03.10. They shall also meet AASHTO Designations M252 and M294 as well as cell specifications in ASTM D3350.

C. Flared end RCP sections shall be fabricated to conform to the requirements of AASHTO M170, Class III except the edge bearing tests shall not be required. The flare shall be of the same thickness and materials as the barrel and shall have steel reinforcement equaling or exceeding the requirements of AASHTO M170, Class III except that a double row of steel will not be required. The end sections shall meet MassDOT Standard Specifications Section 230 and MassDOT Construction and Traffic Standard Details Drawing 206.8.0.

4.3.3 Drainage Structures

4.3.3.1 Manholes

4.3.3.1.1 General

A. Manholes over 12 feet in depth shall have minimum of 5 feet inside diameter. When drop manholes are used the drop shall not be more than 3 ½ feet. Risers shall be brick, not concrete blocks. Risers shall be clay or shale brick, and shall conform to the requirements of AASHTO M 91, Grade MM or as specified in MassDOT M4.05.

4.3.3.1.2 Precast Manholes

A. Precast Manholes shall be constructed of reinforced precast concrete monolithic base section, barrel section and dome section meeting the latest applicable requirements of ASTM C478 I and AASHTO M 199, or latest revision thereto. Special manholes shall also meet the requirements of MassDOT Standard Specifications, section M4.02.14, Precast Units. After curing a minimum of 14 days, the outside surface of the tapered or cone section of precast cement concrete drainage structures shall be dried and cleaned.

B. Tongue and groove sections between barrel sections shall be mortared or use butyl rubber sealants. Live load design shall be H-20 loading. A 26-inch opening will be cast in the top section to accept a standard cast iron frame and cover. Inside diameter shall be a minimum of 4 feet.

4.3.3.1.3 Constructed in Place Manholes

A. Constructed in Place Manholes shall be built of precast sump, 6-inch concrete barrel blocks, and 4-inch (pie) plates with an inside diameter of 4 feet unless set in the groundwater table. Such manholes shall have a solid (impenetrable) sump. Cement concrete blocks shall conform to ASTM C139. Live load design shall be of H-20 loading.

4.3.3.2 Catch Basins

4.3.3.2.1 General

A. All basins shall have a sump of at least 48 inches (4 feet) below the invert of the outlet pipe, or otherwise approved by the DPW, and an inside diameter of 4 feet minimum.

4.3.3.2.2 Precast Catch Basins

A. Precast Catch Basins shall conform to ASTM C478 and AASHTO M 199, or latest revision thereto. A 12-inch opening shall be left in center of the precast base section and filled with washed, screened gravel and left open except when the catch basin is placed in an area of high groundwater. Precast units shall have 2 weep holes built into the walls at floor level of new basins placed in areas above the seasonal high groundwater table. Each weep hole shall consist of 4-inch pipe or equivalent opening to carry water through the wall of the structure. The ends of the pipe shall be left flush with the wall of the structure and covered with ¼-inch mesh galvanized wire screen 23 gauge satisfactorily fastened against wall. The drain weep hole shall be excavated and backfilled with 2 cubic feet of 1 ½-inch washed stone.

B. Live load design shall be H-20 loading. Catch basins which are limited by height shall be installed with a flat top slab, cast in place, designed for H-20 loading and cast iron frame cast in place.

C. Direct inlet catch basins shall conform to D-4.1.

4.3.3.2.3 Constructed in Place Catch Basins

A. Constructed in place catch basins shall be constructed of a precast sump, 6-inch cement block and 4-inch (pie) plates that conform to ASTM C139. The basin shall have a 4 foot inside diameter minimum. Live load design shall be HS-25 loading.

4.3.3.2.4 Leaching Basins

A. Leaching basins shall be per MassDOT Construction and Traffic Standard Details, Drawing 205.20. Leaching basins shall only be used in areas with highly permeable soils where the bottom of the basin is at least 2 feet above seasonal high groundwater. Safe overflow of these devices shall be provided in the event of severe storm events or of clogging of the soils surrounding the device.

4.3.3.2.5 Drop Inlet Catch Basins

A. Drop (aka Direct) inlet catch basins may be connected to standard catch basins. They shall not be connected to drainage manholes unless otherwise approved by DPW.

4.3.4 Frames and Covers

A. Cast Iron shall meet requirements of ASTM A888 “Grey Cast Iron, Cast Iron Class 20.” All castings shall be clean and without blow holes, sand holes or defects of any kind. Cast iron frames and covers shall be clean of all rust, dirt, and scale, and while free and clean shall be given a full coat of coal tar pitch varnish applied hot. Grates shall have the following wording cast into the

outside borders: “Dump No Waste” and “Drains to Waterway”. Text shall be bold capital letters, at least 1 inch high. Placement may be as per manufacturer.

4.3.4.1 Manhole Covers

A. Manhole frames and covers shall be at least Class 25 conforming to ASTM A48 "Standard Specification for Gray Iron Castings." Manhole frame shall have a clear opening of 24 inches and be a minimum of 8 inches in height. The surface of the cover shall have a diamond pattern with the words "FRAMINGHAM DRAIN" cast thereon for drainage manholes, as manufactured by East Jordan Iron Works (formerly LeBaron Foundry Co.) (EJIW) 2110Z/2111A, or equal.

4.3.4.2 Catch Basin Grates

A. Catch basin grates located at low points shall be 24-inch square grate, East Jordan Iron Works (formerly LeBaron Foundry Co.), LF248-2-4F. Single or dual catch basin grate shall consist of a 24-inch square grate LeBaron Foundry Co. L24SG1-000 or approved equal with an 8-inch heavy duty frame (MassDOT Standard). Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water-tight joint.

B. Catch basin cascade grates shall consist of a 24-inch square grate with an 8-inch heavy duty frame (MassDOT Standard) East Jordan Iron Works (formerly LeBaron Foundry Co.), L24SG18L-000 or a L24SG18R-000 (depending on water flow direction) or approved equal with an 8-inch frame. Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water tight joint. Water flowing from left to right requires a Right-Hand Grate. Water flowing from the right to left requires a Left-Hand Grate.

4.3.4.3 Catch Basin Hoods

A. Catch basin hoods shall be used in off-roadway operations such as parking lots and service areas to minimize the entry of oil, gasoline, and debris into drainage pipes. Catch basin hoods shall also be used in urbanized roadways where drainage is contained by vertical curbs and sidewalks are adjacent to the roadway (increasing the likelihood of litter). Catch basin hoods shall protrude no more than 12 inches beyond the end of pipe into the structure. Acceptable hoods are Ground Water Rescue Inc. Eliminator, Best Management Practices Inc. Snout® or equal approved by the DPW.

4.3.5 Granite Curb Inlets (Throat Stones)

A. Granite shall conform to MassDOT Standard Specifications Sections M9.04.0, M9.04.1, and M9.04.2. The back face for a distance of 3 inches down from the top shall have no projections greater than 1 inch. The front shall be straight split, free from drill holes, and shall have no projection greater than 1 inch or depression greater than 1/2 inch for a distance of 10 inches down from the top. For the remaining distance there shall be no depression or projection greater than 1 inch. The ends shall be squared with the top for the depth of the face finish. The granite curb inlet shall be 6 feet in length, plus or minus 1/2 inch from 17 to 19 inches in depth, 6 inches wide at the top and at least 6 inches wide at the bottom. The reveal shall be 10 inches. Curb inlets set on a radius of 160 feet or less shall be cut to that radius. The gutter mouth at least 3 inches in depth and at least 2 feet in length shall be cut in the front face of the stone. If there is no other curbing, or as applicable, transitional curbing shall be required on both sides of the inlet. The transitional curbing shall be 6 feet in length, with a height equal to the inlet and tapering to grade at the end.

4.3.6 Box Culverts, Headwalls, Wing Walls, and Endwalls

A. Culvert, headwall, wingwall, and endwall materials and specifications shall meet MassDOT Standard Specifications Sections 230 and M4, and as shown on MassDOT Construction and Traffic Standard Details, Drawings 206.40 through 206.70, and 207.1.0 through 207.3.0.

B. Stone shall conform to MassDOT , Section 258 and MassDOT Construction and Traffic Standard Details Drawing 206.7.0. Stone size shall be determined by the design storm flow discharging from the pipe. Stone for drainage swales shall be no smaller than 3 inches, unless otherwise approved by the Department.

4.3.7 Perforated Drain Pipe Trenches (Subdrain)

A. Drain Pipe Trenches shall meet MassDOT Standard Specifications Section 260 and MassDOT Construction and Traffic Standard Details Drawing 209.1.0. Perforated pipe shall be either of the following.

- Polyvinyl chloride (PVC) pipe up to and including 15 inches in diameter, conforming to ASTM D3034, SDR 35.
- Perforated, polyethylene (PE) (flexible) pipe and fittings per ASTM D2737. Joints shall be coupling type.

B. Filter fabric shall meet MassDOT Standard Specifications Section 9.50.0 (Table III – Type III Geotextile Fabric: Filtration/Drainage). Filter fabric shall be nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288. Apparent opening size shall be US Sieve 50 or higher.

C. Subdrain bedding and fill material shall be crushed stone, 3/8 inch to 1 inch.

4.3.8 Dry Wells

A. A dry well shall consist of either an excavated pit or a perforated concrete structure with an inside diameter of 5 feet to 12 feet. If an excavated pit, the dry well shall be filled with clean aggregate greater than 1-1/2 inches up to 3 inches. Fill shall be surrounded by filter fabric (Filter fabric shall be as for Perforated Drain Pipe Trenches). An optional observation well may be placed using 4-inch PVC flush with ground surface, and using a screw-top cap with lock.

B. The DEP's Underground Injection Control regulations (310 CMR 27.00) define injection well as "a well into which fluids are being introduced", and specifically cites dry wells as a type of injection well. Therefore, if the dry well is designed so that the depth is greater than the diameter or width or length (whichever is greater), the well must conform to 310 CMR 27.00.

C. The bottom of the dry well shall be at least 3 feet above seasonal high water table or bedrock. The depth of the well shall be 3 to 12 feet.

D. Dry wells shall be designed to treat the runoff volume generated by the 3.25-inch/24-hour (2-year) Stormwater Quality Design Storm (NOAA). Dry wells shall be placed only in soil where the permeability allows a percolation rate of at least 0.50 inch /hour. The dry well shall be designed to empty within three days of filling under normal conditions.

E. Dry wells shall not be used in the following locations:

- In industrial and commercial areas where petroleum products, herbicides, pesticides, or solvents may be loaded/unloaded, stored, or applied within the drainage area, especially locations with soluble heavy metals and toxic organics in the runoff;

- Where the soil around and below the dry well does not have the necessary permeability to infiltrate the entire Stormwater Quality Design Storm runoff volume; or
- Where dry well installation would create a significant risk for basement seepage or adversely impact a septic system's disposal field.

4.3.9 Drainage Swales

A. The use of swales draining across a sidewalk into the gutter is generally unacceptable. In those cases where necessary, Department approval shall be required for the design. Flow shall be limited to less than one (1) cfs. These flows must be included in gutter capacity. Private drainage swales may not be used to drain more than two (2) adjacent subdivision lots. If private drainage facilities are required to drain more than 2 lots the system shall be piped and contained within a recorded private drainage easement. Maintenance of private systems shall be the responsibility of the adjacent property owners.

4.4 Execution

A. All steps shall be inspected and approved by the Department of Public Works before the next step in the process shall begin.

4.4.1 Pipe Laying

4.4.1.1 Minimum Cover over Drainage Pipes

A. The minimum flow line depth for drainage pipes shall be 4 feet. The minimum cover over drainage pipes shall be 3 feet below the pavement slab or as specified by the type of pipe per manufacturer's specifications, whichever is greater. Where the clearance is less than 1 foot below the pavement, provide a design method to maintain the integrity of the pipe and right of way. For drainage pipe outside of the pavement, the minimum cover shall be 18 inches or as specified by the type of pipe, whichever is greater. Drainage pipe shall be installed with minimum distance from sewer / septic pipe as summarized in Section 3.3.1.2 H (substituting drainage for water).

B. No backfilling of the pipe in the trench shall take place unless approved by a DPW inspector.

4.4.1.2 Minimum Drain Pipe Grades

A. Main lines and cross runs – grades 1% minimum

B. Building storm drainage stubs – 1% minimum

C. Subdrain – 0.5% minimum

D. All other – 0.5% minimum.

E. Any slope greater than 8% requires Department approval.

4.4.1.3 RCP Pipe

A. Pipe shall be carefully laid to the lines and grades as shown on the approved plans. The Contractor, when possible, shall use laser beam aligning equipment.

B. See Section 4.3.1 for bedding material. The bottom of the trench shall be excavated to a flat grade 6 inches below the pipe invert for trenches in suitable earth and 12 inches below pipe invert for trenches in rock. When rock or ledge is encountered it shall be removed to such widths as will give a clearance of at least 12 inches on each side of the pipe or other structure and a sand cushion

used. The width of trenches shall be sufficient to allow thorough compacting of the refill adjacent to the lower quarters of the pipe.

C. RCP Pipe Trenches shall meet MassDOT Standard Specifications Section 260 and MassDOT Construction and Traffic Standard Details Drawing 208.10.

D. Trenches at pipe joints shall be excavated as necessary to give ample room for properly making and inspecting the pipe joints. RCP pipe joints shall be cement mortared (as specified in MassDOT Section M4.02) carefully placed in the joints around its entire perimeter and mixed relatively dry, in the ratio of one part cement to two parts sand.

E. Pipe bedding material shall be carefully and lightly tamped under pipe to provide uniform support. Fill to a minimum depth of 12 inches above the top of the pipe. Material for backfilling the rest of the trench, except for sub base (top 15 inches) shall be suitable material, approved by the Department. The compaction process shall be material placed in 12-inch lifts and thoroughly compacted by mechanical rammers, vibrators, or other methods to be approved by the Department (e.g., hydraulic plate compactors) to 90 percent Modified Proctor density in off-road or nonstructural areas and 95% in roadway or structural areas. Bucket compaction will not be accepted.

F. When laying pipe in groundwater, pipe material and method of installation shall be approved by the Department. Water must not be permitted to rise in the trench until all pipes have been securely bedded, jointed and observed by the town and until backfilling has progressed to an elevation at least one foot above the top of the pipe. Temporary plugs shall be installed in open ends of pipe to prevent silt from washing into pipe during construction; and open ends of the pipe shall be closed with suitable plugs upon suspension of the work for any reason.

4.4.1.4 HDPE Pipe

A. The requirements for laying of RCP pipe also apply to HDPE pipe. The following additional requirements apply to HDPE pipe.

B. Installation of HDPE pipe shall be in accordance with either AASHTO Section 30 or ASTM D2321 and as recommended by the manufacturer.

C. Because HDPE pipe will float in standing water, a dry trench shall be provided prior to laying the pipe. A qualified engineer shall be consulted to determine dewatering methods.

D. Haunching large-diameter pipes (greater than 30 inches) shall be performed using maximum 8-inch lifts and compacted to 90 percent standard proctor density.

E. Water tight joints shall be used. Pipe shall be watertight according to the ASTM D3212. Joint design shall be bell-and-spigot with an elastomeric rubber gasket meeting ASTM F477 or equal approved by the Engineering Division.

4.4.1.5 PP Pipe

A. The requirements for laying of HDPE pipe also apply to PP pipe. The following additional requirements apply to PP pipe.

B. Minimum cover in traffic areas through 48-inch ID pipe shall be one foot. Minimum cover for 60-inch ID pipe shall be two feet.

4.4.1.6 Pipe Ends

A. Pipe ends shall be accurately aligned on compacted gravel fill unless otherwise approved by the Department. Rip Rap stone shall be placed to line and grade as shown on the plans on a prepared bed of embankment material or existing materials. Each stone shall be placed by hand, normal to

the slope and firmly embedded. Larger stones shall be placed directly at the drainage end to prevent erosion and displacement. Stone size shall be determined by the design storm flow discharging from the pipe.

4.4.1.7 Pipe Testing

A. At the discretion of the Department, a mandrel test shall be conducted following completion of pipe laying. Placement of curb, gutter, sidewalk, or asphalt concrete pavement shall not occur until the DPW Inspector has approved the mandrel test. The DPW Inspector shall be present through the duration of the mandrel testing. Alternatively, a television survey may be performed on the line after installation, with the results being provided to the Department in electronic format as directed by the Department.

B. The allowable deflection (reduction in vertical inside diameter) for all non-rigid pipe shall be 7.5 percent maximum. The deflection shall be tested by pulling a mandrel which is 92.5 percent of the inside pipe diameter through all installed pipe. The mandrel shall be the "go/no-go" type and shall be pulled without mechanical assistance. At each location in which the mandrel cannot pass, the cause shall be ascertained. Obstacles in the pipe shall be removed. If it is determined that the deflection exceeds 7.5 percent, that a gasket has been improperly installed or that the pipe has been damaged due to trenching for another utility, the respective section of pipe shall be re-bedded or removed, replaced and re-bedded using water tight repair couplings. A passing mandrel retest is required. At the contractor's discretion, any sections of non-rigid pipe not passing the mandrel test may be televised to ascertain the problem.

4.4.2 Manholes, Catch Basins, and Leaching Basins

A. Contractor shall excavate to a depth of 12 inches below the bottom of and all around the proposed manhole or catch basin base, compact and fine grade and install washed screened gravel as a sub-base material. Pipes shall extend no more than 3 inches inside the interior wall and all openings around pipe entrances and lift holes shall be thoroughly grouted with non-shrink grout prior to back filling. Compaction process shall be the same manner as compaction around pipe.

B. The tops of frames and covers shall be set 1/8 inch below finish grade pavement in the street. Final grade locations for installations outside of the paved roadway shall be as approved by the Department.

C. All joints between the frame, grade rings, dome, barrels and base shall be set in place with non-shrink mortar. Inside the manhole, all joints where the sealing material is not flush with the inside wall shall be grouted with nonshrink mortar and finished by hand / wet-brushed.

D. Grade adjustments shall be made using either precast grade rings/risers or clay/shale bricks.

E. No backfilling of the structure in the excavation shall take place unless approved by a DPW inspector.

4.4.2.1 Manholes

A. Manholes shall be constructed in series shall have a distance of no more than 250 feet between manholes, unless otherwise approved by DPW.

B. When ground water is encountered in manholes, ¾-inch to 1-inch washed stone shall be placed around structure to a distance of at least half-way up the barrel of the highest pipe.

C. As circular concrete block walls are laid, the horizontal joints and key ways shall be flush full with mortar. As rectangular blocks are laid, all horizontal and vertical joints shall be flushed full with mortar.

4.4.2.2 Catch Basins

A. When ground water is encountered in catch basins, ¾-inch to 1-inch washed stone shall be placed 2 feet all around structure to a distance of the high ground water elevation. The stone shall be placed against and over the end of the pipe opening to prevent entrance of the finer filling material. All catch basins that do not have a flat top slab designed for H-20 loading and cast iron frame cast in place shall be installed using blocks to make a square hole that will accept a frame and grate, and there shall be at least two full courses of brick for frame adjustment.

B. Circular concrete block walls are laid up the horizontal and key ways shall be flush full with mortar above the outlet invert. The dome or cone section shall be constructed in the same manner. The opening between the pie plates shall be filled with washed, screened gravel and left open. A 24-inch opening shall be left open at the top for a frame and grate.

4.4.2.3 Leaching Basins

A. Leaching basins shall be set in an excavation lined with a geotextile. The basin shall be placed on a pad of free draining crushed stone, with the excavation around the basin back-filled with similar material. Leaching catch basins shall be used as “off-line” devices (that is, they should not generally be piped in series as “flow-through” devices).

4.4.3 Box Culverts, Headwalls, Wingwalls, and Endwalls

A. Headwalls, Wingwalls, and Endwalls shall be constructed at open ends of any drainage pipes where the same serve as outlets or inlets to the drainage system. Metal beam guard rails or chain link fencing may be required by the Department at culverts, headwalls, box culverts, and on steep side slopes.

B. Box culverts shall be designed and installed as per MassDOT Standard Specifications, as amended.

C. Stone shall be placed to line and grade as shown on the plans on a prepared bed of embankment material or existing materials. Each stone shall be placed in a controlled manner, normal to the slope and firmly embedded. Larger stones shall be placed directly at the drainage end to prevent erosion and displacement

4.4.4 Perforated Drain Pipe Trenches (Subdrain)

A. The trench drain shall be excavated to a minimum of 24 inches below grade and lined with filter fabric with a 12-inch overlap on the top of the trench. If the pipes have a single line of perforation, pipe shall be installed with perforations down and backfilled. If there are two lines of perforation, the pipe shall be installed with the perforations on the sides of the pipe and then backfilled. The width of the trench shall be at 12 inches or double the diameter of the drainage pipe, whichever is greater. The end of the pipe shall be capped.

B. Stones or other anchoring objects should be placed on the fabric at the edge of the trench to keep the trench open during windy periods. When overlaps are required between rolls, the uphill roll should lap a minimum of 2 feet over the downhill roll in order to provide a shingled effect.

C. The drainage bedding and fill material shall be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended.

D. Following the stone aggregate placement, the filter fabric shall be folded over the drainage bedding and fill material to form a 12-inch minimum longitudinal lap. The drainage bedding and fill material shall be placed over the lap at sufficient intervals to maintain the lap during subsequent backfilling.

E. Voids can be created between the fabric and the excavation sides and shall be avoided. Removing boulders or other obstacles from the trench walls is one source of such voids; therefore, natural soils should be placed in these voids at the most convenient time during construction to ensure fabric conformity to the excavation sides.

F. Keep trenches dry until pipe is in place and granular material backfill is completed to one foot (12 inches) above top of pipe, unless otherwise noted.

4.4.5 Dry Wells

A. Dry wells shall not be placed in a public way or a public easement, and shall not be placed into service until the drainage area is stabilized. Dry wells shall be sited a minimum of 10 feet away from the building. Excavated material shall be placed away from the excavated sides to prevent wall instability during excavation and backfilling. Large tree roots shall be trimmed flush with the sides to prevent puncturing or tearing of filter fabric during installation. The side walls shall be roughened where sheared and sealed by heavy equipment.

B. An overland flow path of surface runoff exceeding the capacity of the well shall be identified. An overflow system leading to a stabilized channel or watercourse including measures to provide non-erosive flow conditions shall be provided.

C. The following requirements apply to dry wells that do not utilize a concrete structure.

- The bottom, sides and top of the well surface shall be lined with filter fabric. The fabric shall be wrapped and tied with wire or nylon twine or otherwise tightly secured around the horizontal inflow pipe where the pipe protrudes through the fabric. Fabric shall be wrapped over the top of the aggregate fill with a minimum of 12 inches of overlap in any direction. Fabric shall be overlapped 6 inches in “shingle” fashion when more than one section is required to enclose the aggregate.
- The dry well shall be filled to within 12 inches of the finished surface elevation, leaving sufficient depth for topsoil placement (in areas where surface stabilization is accomplished through the use of vegetation).
- Drainage aggregate shall be placed in lifts of no more than 12 inches and compacted using plate compactors. Voids between the fabric and excavation sides due to boulders or other obstacles shall be filled with natural soils to ensure fabric conformity to excavation sides.

4.4.6 Drainage Swales

A. The maximum depth of a swale shall be 24 inches. Side slopes shall be no steeper than 2:1 (horizontal:vertical) with a minimum grade of 0.5 percent and carrying no more than 3 cfs during a five-year design event. The minimum bottom width for a swale, whether earthen, gravel, or paved is 2 feet.

4.4.7 Separation of Storm Drains and Water or Sewer Mains

A. Horizontal Separation: Drainage mains shall be located at least 5 feet horizontally from sewer mains. Locations with respect to water mains are described in the Water Standards portion of these Construction Standards. The distance shall be measured from inside edge of pipe.

B. Vertical Separation: Drainage mains shall be laid to provide a separation of at least 18 inches from either water or sewer lines. The minimum vertical separation is measured from outside of water or sewer main to outside of the storm drain main.

C. Unusual Conditions: Storm drain crossings under unusual conditions must be approved on a case by case basis by the Department.

4.5 Maintenance

4.5.1 Maintenance of Drainage Systems on Private Property

A. The owner of any property on which a drainage system is located is responsible for the maintenance and upkeep of the system. Prior to construction of said drainage system, the owner shall provide documents describe the long term operation and maintenance of all permanent erosion control and stormwater management measures. The inspection and maintenance of the drainage systems shall be performed at minimum on an annual basis, and more frequently depending on the circumstances.

4.5.2 Access for Maintenance of Drainage within Easements

A. Access to all drainage in drainage easements shall be a minimum of 20 feet wide and maintained to allow earth-moving and other construction activities to occur within the easement (see 4.1.2.2).

4.6 Definitions

A. Drainage Swale: A long narrow trench dug into the ground designed to manage stormwater runoff. Swales can be earthen (normally seeded or otherwise vegetated), gravel, or paved.

B. Backflow Preventer: Device that stops the backflow of water into the drainage system.

C. Fiber Rolls (a.k.a. straw wattles): coir (coconut fiber), straw, or excelsior woven roll encased in netting of jute, nylon, or burlap

D. Mandrel Test: The roundness of a pipeline is tested by moving a slightly smaller steel shank, called a mandrel, through the inside of the pipeline. If the pipeline is out of round, the mandrel will be held and kept from moving forward.

E. Haunching: During pipe installation, the action of holding the pipe in a fixed position in terms of lateral movement, usually by filling in both sides of the pipe at the same time.

4.7 References

A. All materials and execution shall conform to the highest applicable standards. If there is a conflict between other standards, or between other standards and these Design standards, then the most stringent criteria shall be used.

B. These standards draw and refer to the *Massachusetts Stormwater Management Standards* and the *Massachusetts Stormwater Handboook* (Massachusetts Department of Environmental Protection, January 2008 et seq.). These standards also draw significantly on the *Commonwealth of Massachusetts - Massachusetts Highway Department: Standard Specifications for Highways and Bridges* (1995 et seq.) and the *Commonwealth of Massachusetts - Massachusetts Highway Department: Construction and Traffic Standard Details* (1996 et seq.). These two documents are referred to collectively as the MassDOT Standards. In addition to the MassDOT Standards, the Town references AASHTO, and ASTM as guidance for the materials and execution of work performed on the Town Drainage Infrastructure. The following summarizes select standards applicable to the sections in these Design Standards. This list is not exclusive; other standards may apply. The latest revision of each standard shall be referenced.

Standard	Title/Subject
N/A	Massachusetts Department of Transportation: Standard Specifications for Highways and Bridges, Construction and Traffic Standard Details (1996 et seq.)
AASHTO Section 30	Division II (General-Interim 1998)
AASHTO M 91	Sewer and Manhole Brick (Made from Clay or Shale)
AASHTO M 170	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
AASHTO M 199	Standard Specification for Precast Reinforced Concrete Manhole Sections (ASTM C478)
AASHTO M 252	Corrugated Polyethylene Drainage Pipe
AASHTO M 288	Standard Specification for Geotextile Specification for Highway Applications
AASHTO M 294	Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter
ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 888	Grey Cast Iron, Cast Iron Class 20
ASTM C 76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity — Flow Applications
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2487	Standard Practice for Classification of Soils for Engineering Purposes (USCS)
ASTM D 2737	Standard Specification for Polyethylene (PE) Plastic Tubing
ASTM D 3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D4101	Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
NOAA	National Oceanographic and Atmospheric Administration: Technical Paper No. 40, May 19“1 "Rainfall Frequency Atlas of the United States"
OSHA 1926	29 CFR 1926 Safety and Health Regulations for Construction